Subject-Specific Competencies for Beginning Teachers in Missouri: Biology

Abbreviations used in this document for coding:

A. **1997 SSC: 2.1** = 1997 Subject Specific Competencies for the Beginning Teacher in Missouri Strand 2, Matter and Energy, competency 1, Properties of matter

B. **CR GenEd, III.D, ScBio** = Missouri Elementary General Education "Natural Science" and "Biology" Certification Requirements

C. **NSTA [2001]: Standard 2.a =** 2001 National Science Teachers Association standards (i.e., those found on the NCATE website: www.ncate.org)

D. **NSTA [1998]** = 1998 National Science Teachers Association standards conveying more detail than do the 2001 standards; suggested by NCATE as a useful cross-reference to the more recent standards

E. **National Science Education Standards (NSES)**:

- Unifying Concepts and Processes (**UCP**)
- Content Standard A (**A**): Science as Inquiry
- Content Standard B (**B**): Physical Science
- Content Standard C (**C**): Life Science
- Content Standard D (**D**): Earth and Space Science
- Content Standard E (**E**): Science and Technology
- Content Standard F (**F**): Science in Personal and Social Perspectives
- Content Standard G (**G**): History and Nature of Science
- Grades K-4: **E**
- Grades 5-8: **M**
- Grades 9-12: **H**

F. **S 1,4** = *Show Me* Science Content Knowledge Standards, standards 1 and 4

G. **ETS 0235, I** = Educational Testing Service (**ETS**) Praxis II test "Biology: Content Knowledge" (test 0235), Topic I (Basic Principles of Science) (i.e., the information provided in "Tests at a Glance" description of the contents of the high school biology test)

Finally, the following materials are provided in this Biology package:

1. a 2-column table representation of science competencies for the beginning high school biology teacher
2. a "narrative" (or list) of the same information in a conventional word processing format

Subject-Specific Competencies for Beginning Teachers in Missouri: Biology

The beginning (preservice) high school biology teacher will demonstrate knowledge of and/or competency in the following areas of study:

1.Unifying Concepts and Processes: is familiar with, and teaches, the major concepts and principles that unify all scientific effort and that are used in each of the science disciplines. (1997 SSC: 1.2; CR GenEd, III.Sc-Bio; NSTA [2001]: Standard 1; NSTA [1998], Standard 1; NSES: UCP-1-5)	1.1 systems, order, and organization; 1.2 evidence, models, and explanation; 1.3 change, constancy, and measurement; 1.4 evolution and equilibrium; and 1.5 form and function
2. Science As Inquiry: understands and practices the science inquiry process. (1997 SSC: 1.1, 1.4; CR GenEd, III.Sc-Bio; NSTA [2001]: Std 3; NSTA [1998], Standard 3; NSES: H-A1, A2; S 7; ETS 0235: I)	2.1 identify questions and concepts that guide scientific investigations. 2.2 design and conduct scientific investigations, including understanding of the major concepts in the area being investigated, of proper equipment, of safety precautions; resolving methodological problems; using technologies; clarifying ideas that guide the inquiry; and obtaining scientific knowledge from sources other than the actual investigation; clarifying the question, method, controls, and variables; organizing and displaying data; revising methods and explanations; and public presentation of the results with a critical response from peers; using evidence; applying logic; and constructing an argument for the proposed explanations. 2.3 use appropriate tools (e.g., hand tools, measuring instruments, calculators, and computers for the collection, summary, and display of evidence), techniques, and mathematics to gather, analyze, and interpret data, including selecting the scientific apparatus or instrument appropriate to a specified laboratory or field task and identifying proper operation of such equipment; using the metric system of measurement, recognizing equivalents within that system and selecting units appropriate to a given laboratory or field task; converting between scientific notation and conventional numerals and using scientific notation to perform calculations. 2.4 formulate and revise scientific explanations and models using logic and evidence, including discussing, formulating, and revising an explanation or physical, conceptual, and/or mathematical models based on scientific knowledge, use of logic,

	and evidence from the investigation. 2.5 think critically and logically to make the relationships between evidence and explanations, including deciding what evidence should be used and accounting for anomalous data; reviewing data from an experiment, summarizing the data, and forming a logical argument about the cause-and-effect relationships in the experiment; and stating some explanations in terms of the relationship between two or more variables. 2.6 recognize, construct, and analyze alternative explanations and models, including the abilities of analyzing an argument by reviewing current scientific understanding, weighing the evidence, examining the logic so as to decide which explanations and models are best, and using scientific criteria to find the preferred explanations. 2.7 communicate and defend a scientific argument, including writing and following procedures, expressing concepts, reviewing information, summarizing data, using language appropriately, developing diagrams and charts, explaining statistical analysis, speaking clearly and logically, constructing a reasoned argument, and responding appropriately to critical comments. 2.8 use mathematics in all aspects of scientific inquiry to ask questions; to gather, organize, and present data; and to structure convincing explanations.
3. Physical Science: understands the central concepts, tools of inquiry, and structures of the physical sciences and makes these aspects of subject matter meaningful for students. (1997 SSC: 2.1-2.8, 3.1-3.7; CR GenEd, III.Sc-Bio; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: H-B1, B3; S 1, 2, 7-8; ETS 0235: II)	3.1 Structure of Atoms (NSES: H-B1) 3.2 General Chemistry and Chemical Reactions in Physical and Life Science (1997 SSC: 2.2-.5; NSES: H-B3; ETS 0235: II)
4. Life Science: understands the central concepts, tools of inquiry, and structures of the life sciences and makes these aspects of subject matter meaningful for students. (1997 SSC 4.1-.7, 5.1-.6; CR GenEd, III.Sc-Bio; NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: H-C1, C2, C3, C4, C5, C6; S 3, 4, 7-8; S	4.1 Structure and Function in Living Systems (1997 SSC: 4.3-.7; NSES: high-school extension of M-C1) 4.2 The Cell (1997 SSC: 4.4; NSES: H-C1) 4.3 Molecular Basis of Heredity (1997 SSC 4.2; NSES: H-C2) 4.4 Biological Evolution (NSES: H-C3) 4.5 Interdependence of Organisms (NSES: H-C4) 4.6 Behavior of Organisms (NSES: H-C6) 4.7 Matter, Energy, and Organization in Living Systems

3, 4, 7-8; ETS 0235: II, IV, V)	(NSES: H-C5)
5. Earth and Space Science: understands the central concepts, tools of inquiry, and structures of the earth and space sciences and makes these aspects of subject matter meaningful for students.	**NOTE:** No competencies have been identified for earth/space science. If competencies were identified, they would be coded as follows: (1997 SSC 6.1-.7, 7.1-.5; CR GenEd, III.Sc-Bio (A2"); NSTA [2001]: Rationale; Standard 1; NSTA [1998], Standard 1; NSES: M-D1, D2, D3; S 5-8; S 5-8)
6. Science and Technology: understands the relationship between science and technology, can distinguish between natural objects and objects made by humans, and makes these aspects of subject matter meaningful for students by creating experiences in making models of useful things and by developing students= abilities to identify and communicate a problem and to design, implement, and evaluate a solution. (1997 SSC: 1.3, 1.4; NSTA [2001], Standards 4, 5.d; NSTA [1998] Standards 2, 4, 5; NSES: H-E1, E2, E3 S 8; ETS 0235: VI)	6.1 compare/contrast scientific inquiry and technological design (NSES: H-E2) 6.2 explain the reciprocal relationship between science and technology (NSES: H-E2) 6.3 explain why technological knowledge is often not made public (e.g., patents and the financial potential of the idea or invention) while scientific knowledge is made public through presentations at professional meetings and publications in scientific journals (NSES: H-E2) 6.4 explain the intended and unintended consequences of technological designs (NSES: H-E2) 6.5 identify appropriate problems for technological design (NSES: H-E2) 6.6 use computer and related technologies to extend investigative activities (NSES: H-E2) 6.7 identify and organize materials and other resources, choose suitable tools and techniques, and work with appropriate measurement methods to ensure adequate accuracy in the implementation of a proposed design. (NSES: H-E1) 6.8 analyze and interpret data obtained from an experiment or investigation, including graphical data, and identify and demonstrate an understanding of sources of error in data that is presented (NSES: H-E1) 6.9 demonstrate understanding of scientific measurement and notation systems, including systems for describing very large and very small units (NSES: H-E1) 6.10 collaborate as a team-member in the identification, communication, and resolution of scientific and technological problems. (NSES: H-E2) 6.11 describe how scientific investigations require the contributions of individuals from different disciplines, including engineering, and how problems contribute to the formation of new disciplines of science (e.g., geophysics, biochemistry) (NSES: H-E1) 6.12 use words, drawings, and models to communicate the process and products of technological design and scientific investigation (NSES: H-E1)

	6.13 use criteria relevant to the original purpose or need to evaluate completed technological designs or products (NSES: H-E1)
7. Science in Personal and Social Perspectives: understands the context of science (relationships among systems of human endeavor including science and technology; relationships among scientific, technological, personal, social and cultural values; and the relevance and importance of science to the personal lives of students) and the social context of science teaching (the social and community support network within which science teaching and learning occur; relationship of science teaching and learning to the needs and values of the community; and involvement of people and institutions from the community in the teaching of science) and uses this knowledge to enrich the science learning of all students. (1997 SSC: 1.3, 4.3, 4.6, 5.1, 5.4-.6, 6.1; NSTA [2001]: Standards 4, 7; NSTA [1998], Standards 4, 7; NSES: M-F1, F2, F3, F4, F5, F6; S 1, 3-5; ETS 0235: VI)	7.1 Personal and Community Health (1997 SSC: 4.3, 4.6; NSES: H-F1) 7.2 Population Growth (1997 SSC: 5.1, 5.4-.6; NSES: H-F2) 7.3 Natural Resources (1997 SSC: 6.1; NSES: H-F3) 7.4 Environmental Quality (1997 SSC: 5.1, 5.6; NSES: H-F4) 7.5 Natural and Human-induced Hazards (1997 SSC: 1.3; NSES: H-F5) 7.6 Risks and Benefits (1997 SSC: 1.3; high-school extension of NSES: M-F4) 7.7 Science and Technology in Local, National, and Global Challenges (1997 SSC: 1.3; NSES: H-F6)
8.History and Nature of Science (incorporates the existing strand "The Nature of Science"): understands the history and nature of science as a human endeavor and uses this knowledge to make subject matter meaningful for students. (1997 SSC: 1.3, 4.3, 4.6, 5.1, 5.4-.6, 6.1; NSTA [2001]: Standard 2.a & 2.b, 4; Standard 7; NSTA [1998], Standard 2.d, 4.b; NSES: E-G1, G2, G3; S 1-8; ETS 0235: I)	8.1 Science as a Human Endeavor (1997 SSC: 1.2, 1.5, 1.6; NSES: H-G1) 8.2 Nature of Scientific Knowledge (1997 SSC: 1.2, 1.5, 1.6; NSES: H-G2) 8.3 Historical Perspectives (1997 SSC: 1.2, 1.5, 1.6; NSES: H-G3)